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Two New Cave Millipeds of the Genus *Epanerchodus*
from Shikoku, Japan*

With 2 Text-figures

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ABSTRACT Two new troglobiontic millipeds of the genus *Epanerchodus* are described from Kôchi Prefecture in the Island of Shikoku, Southwest Japan. They are: *E. unispinatus* n. sp. and *E. kawasawai* n. sp. Both the new species belong to the species-group that consists only of troglobiontic forms endemic to the Pacific side of the island. All the known members of this species-group are very similar to one another in the form of narrow body segments and in that the tibiotarsus of male gonopods has no branch.

There are well developed caverniferous limestone strata stretching from east to west in Kôchi Prefecture. The caves lying in these strata maintain very interesting endemic faunas, which include a series of small troglobiontic polydesmid millipeds of the genus *Epanerchodus*. In 1941, *E. isikawai* was first made known by Verhoeff (p. 114, figs. 1–6) from Ryûga-dô Cave. Later, many caves in the same area were biospeologically investigated by several zoologists, and four more endemic species were discovered in the four caves, Shôbu-dô, Wakamiya-dô, Saruta-dô and Konpira-dô. They were reported by Miyosi in 1955 under the names *E. spinosus*, *E. wakamiyadensis*, *E. applanatus* and *E. simplicicornutus*. More recently, the present author (1968, p. 165) described the sixth species (*E. porrectus*) from Mizuidé-dô Cave.

In recent years, more extensive cave surveys have been carried on by Dr. Shun-ichi Uéno and Mr. Tetsuo Kawasawa, who have already visited or re-visited about five dozen caves and potholes in the area under consideration. They collected many cave-dwelling myriapods and submitted them to the present author for study. Their collections contain small troglobiontic species of the genus *Epanerchodus*, of which at least five seem to be new to science. The two species to be described in the present paper doubtless fall in the same group as the above-mentioned species, since

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their body segments are characteristically narrow and the tibiotarsus of male gonopods has no branch. They are, however, discriminated from any of the six species previously described by the details of male gonopods.

The holotypes and a part of the paratypes of the new millipeds will be deposited in the collection of the National Science Museum, Tokyo. Other specimens will remain in the author's collection.

Epanerchodus unispinatus n. sp.

[Japanese name: Sanpô Obiyasude]

(Fig. 1)

Diagnosis. Small troglobiontic species very similar to *E. isikawai* Verhoeff (1941, p. 114, figs. 1–6), but readily distinguished from the latter by the details of the male gonopods.

Male holotype. Color pure white. Length approximately 15 mm, greatest width 1.6 mm. Body small and slender, with conspicuous sculpture on dorsum. The shape of head and of some selected segments as shown in Fig. 1 A–C; the widths of them as follows:

Head = 1.4 mm	Collum = 1.2 mm	Seg. 2 = 1.3 mm
Seg. 3 = 1.1 mm	Seg. 5 = 1.3 mm	Seg. 7 = 1.5 mm
Seg. 10 = 1.6 mm	Seg. 17 = 1.6 mm	Seg. 18 = 1.3 mm.

Head large, subglobular, and densely covered with short or minute hairs. Antennae slender, approximately 2.8 mm long, and reaching back to the anterior border of segment 5; the ratio in length and in width (in parentheses) of articles 5 through 7 is 16(5.5) : 15(8) : 6(5); sensory groups on each of them usually well developed. Collum elliptical, narrower than head; posterior corners slightly angular; each side with a small notch bearing a minute bristle; a row of bristles present along the anterior margin and two rows of them on the surface; weak impression present at middle. Segment 2 with three rows of conspicuous tubercular sculpture of the same general pattern on dorsum, each tubercle in the first and second rows bearing a minute subclubbed bristle; lateral keels somewhat expanded forward at the scapular area, with the outer margin nearly straight and posterior corners hardly produced. Segments 3 and 4 narrower than most of the succeeding segments; dorsum with conspicuous sculpture bearing minute bristles; keels somewhat rising upward, the outer margin slightly convex, posterior corners well produced. Succeeding segments gradually increasing in width to segment 10, parallel-sided between 10–17, and gradually narrowing to the last segment; dorsum of each segment moderately arched, with conspicuous sculpture bearing very fine bristles; typical form of body segments as shown in Fig. 1 B. Lateral keels narrow, moderately rising; posterior corners well produced, the teeth of segment 19 long and parallel; lateral margin moderately convex, with 3–4 small conspicuous notches which usually bear no bristles; segment 7 through 18 provided with microscopic strigils on the surface along the anterior and posterior margins. Pores small, open on the depressed lateral

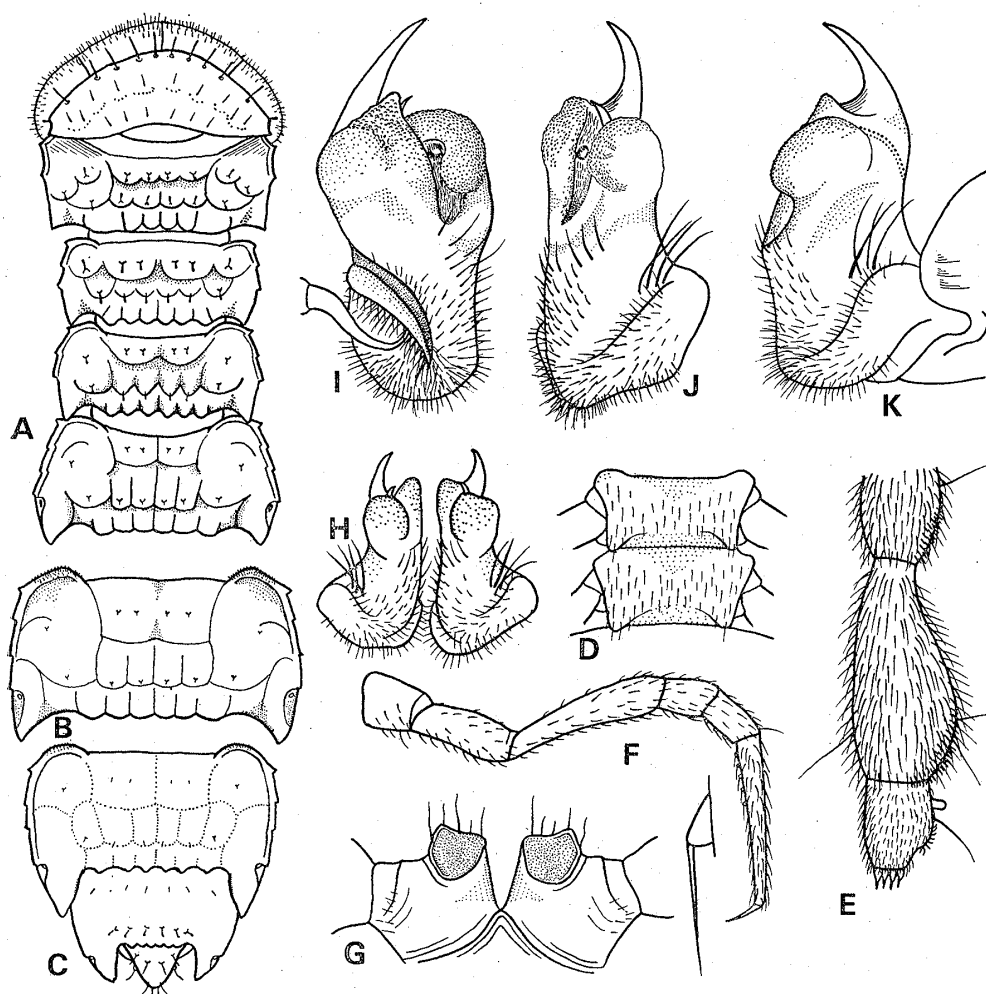


Fig. 1. *Epanerchodus unispinatus* n. sp., holotype.—A, Head and five succeeding segments, dorsal aspect. B, Segment 12, dorsal aspect. C, Caudal end of body, dorsal aspect. D, Ventral aspect of segment 17. E, Last two articles of antenna. F, Right leg on segment 12. G, Coxae of 2nd legs, anterior aspect. H, Gonopods, *in situ*, ventral view. I, Left gonopod, mesial aspect. J, The same, ventral aspect. K, The same, lateral aspect.

margin just behind the fourth notch of pore-bearing keels. Legs long and slender; femur slightly incurved; postfemur, tibia and tarsus with small spherical bristles on the ventral surface in anterior segments; claw rather long and acute. Coxae of leg 2 distally protuberant. Sternites quadrate, pubescent, and with transverse furrow; posterior corners produced on segments 8 through 18.

Gonopods small and simple, of the form as illustrated in Fig. 1 H–K. Femoral clivus thick and knob-like, with minutely roughened surface; disto-internal portion of femur moderately swollen and protuberant, and with rough surface; postfemoral process very small. Tibiotarsus relatively short and extremely simple, forming a spine-like process.

Female unknown.

Type-series. 2 ♂♂ (including holotype), 5 larvae, 1 May 1968, Sanpô-dô Cave, at Nuta of Saoka, in Tosayamada-chô, Kôchi Prefecture. All the specimens were collected by S. Uéno and K. Mizushima.

Notes. This new species no doubt falls in the line of *E. isikawai*, as is indicated by the narrow form of body segments and by the simple tibiotarsus of male gonopods. However, it can be recognized on the following particulars of gonopodal features: tibiotarsus not so long and flattened as in *E. isikawai*; outer horn entirely absent; disto-inner portion of femur swollen and protuberant.

Sanpô-dô Cave, the type-locality of this new species, is located on the right side of the Monobé-gawa River. It is about 8 km distant to the north beyond the river from Ryûga-dô Cave. Cavernicoles are fairly abundant throughout the cave (cf. Uéno, 1969, p. 22), and the present new polydesmid is said to have been found at various parts in the dark zone, particularly in very wet places.

Epanerchodus kawasawai n. sp.

[Japanese name: Kawasaki Obiyasude]

(Fig. 2)

Diagnosis. Small troglobiontic species related to *E. wakamiyadensis* Miyosi (1955, pp. 60 and 62, fig. 2) and to *E. spinosus* Miyosi (1955, pp. 59 and 62, fig. 1); nearer to the former in the shape of gonopods, especially in having moderately long postfemoral process, but distinguished from it by the spine-shaped postfemoral process and by the inflexed tibiotarsus.

Male holotype. Color pure white. Length approximately 19 mm, greatest width 1.6 mm. Body small, slender, almost parallel-sided between segments 9 and 17; dorsal sculpture conspicuous. The shape of head and of some selected segments as shown in Fig. 2 A-C; the width values of them as follows:

Head = 1.4 mm	Collum = 1.3 mm	Seg. 2 = 1.4 mm
Seg. 3 = 1.1 mm	Seg. 4 = 1.1 mm	Seg. 5 = 1.4 mm
Seg. 7 = 1.5 mm	Seg. 9 = 1.6 mm	Seg. 18 = 1.3 mm.

Head large, subglobular, and densely covered with short or minute hairs. Antennae slender, approximately 3 mm in length, reaching back to the posterior margin of segment 4; articles 2-4 cylindrical; article 5 subclavate; the ratio in length and in width (in parentheses) of articles 5 through 7 is 18(6):16(8):9(6); sensory groups on these articles well developed. Collum slightly narrower than head or segment 2, elliptical, angulate at the posterior corners, and with a minute notch at each lateral side; three series of erect bristles present on the surface, ten in the anterior series, and six in the middle and posterior ones respectively; very weak impression present in front of the posterior margin. Segment 2 with three rows of conspicuous tubercular sculpture in the same general pattern on dorsum, and each tubercle excepting those of the third row bearing a small bristle; keels with expanding scapular area, and with almost parallel sides; the posterior corners well produced.

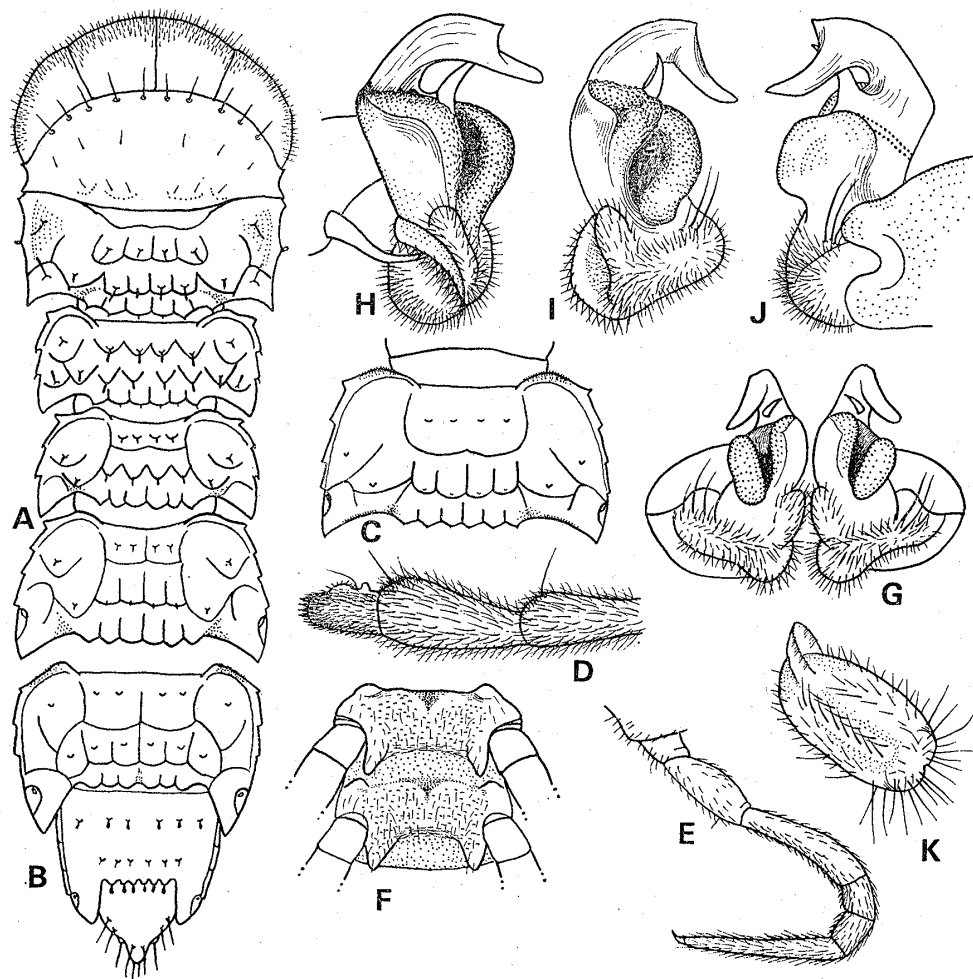


Fig. 2. *Epanerchodus kawasawai* n. sp., A-J, holotype; K, a female paratype.—A, Head and five succeeding segments, dorsal aspect. B, Caudal end of body. C, Segment 7, dorsal aspect. D, Last two articles of antenna. E, Left leg on segment 8. F, Ventral aspect of segment 18. G, Gonopods, *in situ*, ventral view. H, Left gonopod, mesial aspect. I, The same, ventral aspect. J, The same, lateral aspect. K, Cyphopod, ventral aspect.

Segments 3 and 4 narrower than most of the succeeding ones; dorsum with conspicuous sculpture on the surface; lateral keels narrow and slightly reflexed; posterior corners acutely produced. Succeeding segments with well sculptured dorsum; typical form of body segments as shown in Fig. 2 C. Lateral keels well developed, slightly reflexed, the width being narrower than the length; outer margin moderately convex, with 3-4 small, conspicuous notches; posterior corners acutely produced; scapulae of segments 8-18 and posterior margin of segments 7-17 provided with microscopic strigils; teeth of segment 19 long and parallel. Pores small, opening on the depressed lateral margin just behind the fourth notch of pore-bearing keels.

Sternites quadrate, pubescent, and with deep transverse furrow; the surface minutely granulated; posterior corners produced into triangular knobs from segment 8, which gradually become more conspicuous back to segment 19; anterior corner with a small protuberance on each posterior segment. Legs slender, last two podomeres of tibia and tarsus with small spherical bristles; length relationship of podomeres: $6 > 3 > 2 > 4 = 5 > 1$; claw small. Coxae of leg 2 distally protuberant.

Gonopods small (longitudinally about 0.5 mm in length excluding coxa) and diminutive in appearance; telopodites, *in situ*, as shown in Fig. 2 G. Femoral clivus roundly swollen, with minutely roughened surface; the inner margin somewhat protuberant and rough. Postfemoral process rather long, spine-shaped and moderately curved. Tibiotarsus relatively broad in proximal half, abruptly inflexed in distal half and angulate at about middle; distal half of tibiotarsus twisted disto-laterad in ventral aspect, and somewhat flat.

Female paratype. Length approximately 20 mm, greatest width 1.9 mm. Other somatic characters are as in the male.

Type-series. 1♂ (holotype), 1♀, 1 August 1969, Gosanjo-gongen-no-ana Cave, at Tsuzumi, Tosayama-mura, Tosa-gun, Kôchi Prefecture, coll. by S. Uéno; 1♂, 5 May 1969, the same locality, coll. by T. Kawasaki.

Notes. The type-locality of this new species is a small cave lying near the top of a small ridge. According to Dr. Uéno, all the cave animals inhabiting this small cave are rare probably due to the lack of favourable habitats. *Epanerchodus kawasawai* is not exceptional, having been known only by three specimens despite of the repeated investigations made by Dr. Uéno, Mr. Kawasaki and their collaborators.

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